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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/591,476	09/01/2006	Yasuhiko Kojima	33082M343	1461
441 7590 07/12/2011 SMITH, GAMBRELL & RUSSELL 1130 CONNECTICUT AVENUE, N.W., SUITE 1130 WASHINGTON, DC 20036			EXAMINER LOUIE, MANDY C	
			ART UNIT 1715	PAPER NUMBER
			MAIL DATE 07/12/2011	DELIVERY MODE PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

**Office Action Summary****Application No.**

10/591,476

**Applicant(s)**

KOJIMA ET AL.

**Examiner**

MANDY LOUIE

**Art Unit**

1715

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 15 April 2011.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 2-14, 17, 18 and 20-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 2-14, 17-18, 20-24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-940)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB-08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

1. In view of the appeal brief filed on 04/15/11, PROSECUTION IS HEREBY REOPENED. New grounds of rejections are set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:

/Timothy H Meeks/

Supervisory Patent Examiner, Art Unit 1715.

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 2 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Powell [US 6464779] in view of Mouche.

As to claim 2, Powell teaches a copper atomic layer chemical vapor deposition (ALD) method [title] which provides a copper source material (copper diketonate) onto a substrate [col 5, ln 44-60] and supplying a reductive gas to the substrate after stopping the supply of the source material, wherein the step of supplying the source material and the step of supplying the reductive gas are performed alternately [col 6, ln 5-30; Fig. 3]. However, Powell does not disclose the source material including a Cu-carboxylic acid complex or derivative thereof. Mouche Remedies this.

As to claim 2, Mouche teaches a film deposition method for forming a Cu film on a substrate by a CVD by using a source material containing a Cu-carboxylic acid complex or a derivative thereof (i.e. hydrated copper formate) [pg. 1-2].

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide a Cu-carboxylic acid complex such as hydrated copper formate as a precursor for the ALD process of Powell. One would have been motivated to do so with reasonable expectation of success in a vapor deposition process since Mouche teaches these types of precursors are advantageous over copper diketonate (i.e. reduction of fluorine contamination) [pg 1, col 2] and have the benefits of safety, efficiency, and low cost [pg 2, col 1].

As to claim 5, Powell teaches the reductive gas is converted into radicals by using plasma when the gas is supplied [col 6, ln 20-25].

3. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Mouche, and further in view of Fair [US 6849122].

Teaching of the prior art is aforementioned, but does not disclose the reductive gas is H<sub>2</sub> gas, even though Powell teaches the reductive gas is converted into hydrogen radicals [col 6, ln 23-24]. Fair remedies this.

Fair teaches a method of depositing monolayers of metal [abstract] where reductive gas can include excited molecular H<sub>2</sub> gas [col 10, ln 45-51].

It would have been obvious to one of ordinary skill in the art to provide H<sub>2</sub> gas as the reductive gas. One would have been motivated to do so to provide a sufficient reactive specie to reduce the deposited monolayer into copper metal.

4. Claims 3-4, 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Mouche, and further in view of Sneh [2001/0002280].

Teaching of prior art is aforementioned, but appears to be silent in removing residual gases between steps and repeating the steps.

Regarding claim 3, Sneh teaches a film deposition method for radical assisted sequential CVD [abstract] comprising the steps of: placing a substrate in a process container for treatment (which would be innate); and repeating the processing steps [0042] which includes removing residual gases in the process container therefrom after stopping supplying the source material; supplying a reductive gas to the substrate; and removing residual gases in the process container therefrom [0039-0042].

It would have been obvious to one of ordinary skill in the art at the time of the invention to repeat and sequentially purge gases between process steps. One would have been motivated to do so in order to control the amount of material deposit per step so as to ensure reactivity between the sources so as to yield desirable film results (i.e. desirable thickness). Although the prior art does not explicitly teach stopping the reduction gas flow prior to purging, it would have been obvious to one of ordinary skill in the art to do so to reduce material waste of the reduction gas (as similarly applied to the source gas taught by Sneh).

Regarding claim 4, Sneh teaches the film deposition method according to claim 3, wherein the steps (b) and (d) are performed by replacing atmosphere in the process container with an inert gas, or by evacuating the processing container [0040].

Regarding claim 17, Powell teaches the reductive gas is converted into radicals by using plasma when the gas is supplied [col 6, ln 20-25].

5. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Mouche and Sneh, and further in view of Fair.

Teaching of the prior art is aforementioned, but does not disclose the reductive gas is H<sub>2</sub> gas, even though Powell teaches the reductive gas is converted into hydrogen radicals [col 6, ln 23-24]. Fair remedies this.

Fair teaches a method of depositing monolayers of metal [abstract] where reductive gas can include excited molecular H<sub>2</sub> gas [col 10, ln 45-51].

It would have been obvious to one of ordinary skill in the art to provide H<sub>2</sub> gas as the reductive gas. One would have been motivated to do so to provide a sufficient reactive specie to reduce the deposited monolayer into copper metal.

6. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Mouche, and further in view of Krupoder [Polyfluorocarboxylates. I. Copper(II) trifluoroacetate and its analogues].

Teaching of Mouche in view of Norman is aforementioned, but appears to be silent in teaching the limitations of claim 7. Krupoder remedies this.

Regarding claim 7, Krupoder teaches copper trifluoroacetate may be a suitable source material for forming a copper film [abstract].

It would have been obvious to one of ordinary skill in the art at the time of invention to use copper trifluoroacetate as a source material for forming copper film. One would have been motivated to do so in order to gain the advantageous of using such precursor (i.e. less complicated synthesis) [Krupoder pg. 1].

7. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Mouche and Sneh, and further in view of Krupoder [Polyfluorocarboxylates. I. Copper(II) trifluoroacetate and its analogues].

Teaching of Mouche in view of Norman and Sneh is aforementioned, but appears to be silent in teaching the limitations of claim 20. Krupoder remedies this.

Regarding claim 20, Krupoder teaches copper trifluoroacetate may be a suitable source material for forming a copper film [abstract].

It would have been obvious to one of ordinary skill in the art at the time of invention to use copper trifluoroacetate as a source material for forming copper film. One would have been motivated to do so in order to gain the advantageous of using such precursor (i.e. less complicated synthesis) [Krupoder pg. 1].

8. Claims 8, 11-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Chen [US 2003/0129308].

Teaching of Powell is aforementioned, but appears to be silent in teaching the time deposition durations of claims 8. Chen remedies this.

Regarding claim 8, Chen teaches a film deposition method that alternately performing a step of supplying a Cu-containing source material onto a substrate and a step of supplying a reductive gas to the substrate after stopping supplying the Cu-containing source material, wherein said method has: a first film deposition period in an early deposition stage in which the two steps are performed alternately and each of the steps of supplying the reductive gas is performed for a first period of time C1; and a second film deposition period following the first film deposition period in which the two steps are performed alternately and each of the steps of supplying the reductive gas is performed for a second period of time C2, which can be either be longer or shorter than the period of time C1 [0060]. Since Chen teaches that the deposition cycles of the first deposition and second deposition can be different, and there is a finite number of options for the deposition cycles being different (such as C1 is shorter than C2 or C1 is larger than C2), it would have been obvious to one of ordinary skill in the art to modify the deposition duration with reasonable expectation of success.



It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the period at which each reduction gas step is performed as taught by Chen. One would have been motivated to do so in order to improve desirable reaction for film formation [Chen, 0053].

Regarding claim 11, Chen teaches the film deposition method according to claim 8, wherein the first film deposition period continues until Cu deposited on the substrate becomes a continuous film, and the second film deposition period continues until a Cu film with a desired thickness is formed on the substrate [Chen, 0061].

Regarding claim 12, although the prior art does not explicitly teach the film deposition method according to claim 8, wherein the first period of time T1 is in a range of 3 to 20 seconds and the second period of time T2 is in a range of 1 to 5 seconds, it would have been obvious to one of ordinary skill in the art to optimize the amount of time during each process step as a workable parameter in order to yield predictable results (i.e. desirable thickness, film properties (Chen, 0053)).

Regarding claim 13, Powell teaches the reductive gas is converted into radicals by using plasma when the gas is supplied [col 6, ln 20-25].

9. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Chen, and further in view of Fair.

Teaching of the prior art is aforementioned, but does not disclose the reductive gas is H<sub>2</sub> gas, even though Powell teaches the reductive gas is converted into hydrogen radicals [col 6, ln 23-24]. Fair remedies this.

Fair teaches a method of depositing monolayers of metal [abstract] where reductive gas can include excited molecular H<sub>2</sub> gas [col 10, ln 45-51].

It would have been obvious to one of ordinary skill in the art to provide H<sub>2</sub> gas as the reductive gas. One would have been motivated to do so to provide a sufficient reactive specie to reduce the deposited monolayer into copper metal.

10. Claims 9-10, 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Sneh and Chen.

Teaching of Norman (providing copper ALD process and hydrogen radical for reductive gas), Sneh (removing residual gases between deposition), and Chen (deposition duration) as taught in paragraphs 2, 4, and 8 are further applied to claims 9-10 and 21-23.

11. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell in view of Sneh and Chen, and further in view of Fair.

Teaching of the prior art is aforementioned, but does not disclose the reductive gas is H<sub>2</sub> gas, even though Powell teaches the reductive gas is converted into hydrogen radicals [col 6, ln 23-24]. Fair remedies this.

Fair teaches a method of depositing monolayers of metal [abstract] where reductive gas can include excited molecular H<sub>2</sub> gas [col 10, ln 45-51].

It would have been obvious to one of ordinary skill in the art to provide H<sub>2</sub> gas as the reductive gas. One would have been motivated to do so to provide a sufficient reactive specie to reduce the deposited monolayer into copper metal.

***Response to Arguments***

12. Upon further consideration, new grounds of rejection with Powell has been introduced.

13. Applicant's arguments filed 04/15/11 have been fully considered but they are not persuasive.

Arguments against the combination of Mouche and Norman are moot in light of the new prior art, Powell.

Regarding applicant's arguments of Chen failing to teach a first film deposition period (T1) is performed longer than the second film deposition period (T2); it is refuted that since Chen teaches that the deposition cycles of the first deposition and second deposition can be different, and there is a finite number of options for the deposition cycles being different (such as C1 is shorter than C2 or C1 is larger than C2), it would have been obvious to one of ordinary skill in the art to modify the deposition duration with reasonable expectation of success.

Regarding applicant's arguments of unexpected results of using ALD with Cu carboxylic acid are not persuasive since no evidence was provided to support such findings or arguments. Arguments of counsel cannot take the place of factually supported objective evidence. See, e.g., *In re Huang*, 100 F.3d 135, 139-40, 40 USPQ2d 1685, 1689 (Fed. Cir. 1996).

***Conclusion***

1. No claim is allowed.

2. Claims 2-18, 17-18, 20-24 are rejected for the reasons aforementioned.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MANDY C. LOUIE whose telephone number is (571)270-5353. The examiner can normally be reached on Monday to Friday, 7:30AM - 5:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571)272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/M. C. L./  
Examiner, Art Unit 1715

/Timothy H Meeks/  
Supervisory Patent Examiner, Art Unit 1715